**Texas Society for Ecological Restoration**

# TXSER 2015 Annual Conference: Celebrating 20 Years of Ecological Restoration in Texas

*Conference Abstracts*

**Keynote Address by:**

**Steven Whisenant, Ph.D.**
**Professor Emeritus**
**Ecosystem Science and Management**
**&**
**Senior Scientist**
**Normal Borlaug Institute for International Agriculture**
**Texas A&M University**
**College Station, TX**

Trinity University
Center for the Sciences & Innovation
San Antonio, Texas
November 13-15, 2015

# TXSER 2015 Annual Conference: Celebrating 20 Years of Ecological Restoration in Texas

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## Gratitude

Many individuals played a role in the organization of this conference. From its inception, the TXSER Board of Directors visualized this 20th year celebration as an opportunity to review how far we have come in the field of restoration ecology, to analyze current knowledge and practice, and to plan for the future. Board members have been instrumental in developing ideas for speakers, field trips, organizing the plant identification competition, and pulling together the many pieces of the conference, great and small. Many thanks to all of you who have been so active in pulling this conference together!

We would especially like to thank our sponsors whose support has enabled us to bring together individuals and organizations involved in ecological restoration across the State of Texas and beyond. Your support allows us to share our collective experiences and ideas, and to enhance collaboration across our broad geographical area. Your contribution to making this happen is much appreciated!

A heart-felt thank you to all!

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## Keynote Speaker

**Steven Whisenant, Ph.D.**
**Professor Emeritus, Ecosystem Science and Management and Senior Scientist, Norman Borlaug Institute for International Agriculture, Texas A&M University, College Station, TX**
**Contact: rangerider@mac.com**

Dr. Steven Whisenant is Professor Emeritus of Ecosystem Science and Management at Texas A&M University and currently serves as Senior Scientist for the Norman Borlaug Institute for International Agriculture in College Station.

Whisenant previously taught courses on Restoration Ecology; International Sustainability and Community Development; and Leadership, Development, and Management of Environmental NGOs. He recently returned from Bor, South Sudan where he lived and served as the A&M Norman Borlaug Institute for International Agriculture Chief of Party for a USAID-funded agricultural and environmental project focused on Higher Education.

A founding member of TXSER, Whisenant also served on the SER Board of Directors from 2003-2014 and as Chair of the SER's Board of Directors from 2011-2013.

Whisenant is author of "Repairing Damaged Wildlands: A Process-Oriented Landscape-Scale Approach," a book, often found soiled and dog-eared, gracing many of our selves. This book has been the best-selling ecological restoration book for 15 years and has also been translated into Chinese.

Dr. Whisenant will share with conference participants his thoughts on changes in the field of ecological restoration over the last 20 years as well as insights on the links between local restoration efforts and global issues and concerns.

## Saturday Plenary Speaker

**Mitchell Greer, Ph.D.**
**Assistant Professor of Biological Sciences at Fort Hays State University, Fort Hays, KS**
**Contact: mjgreer@fhsu.edu**

Dr. Mitchell Greer, Assistant Professor of Biological Sciences at Fort Hayes State University in Kansas currently teaches courses on Grassland Ecology, Plant Taxonomy, and Rangeland Management. His research has involved the study of invasive grasses and their effects on the flora and fauna of native species. He is currently working on a project with Northern Arizona University's NSF-funded genomics laboratory to sequence bacteria, fungi, and mycorrhiza of Old World Bluestem (OWB) soils to compare with that of native prairie soils. Many of his OWB samples were taken from Wild Mercury Preserve near Kendalia, TX.

Greer received two Bachelors of Science degrees in Biology from South Dakota State University (SDSU), the first emphasizing wildlife and fisheries science and the second, ecology. He went on to obtain an MS in Biology from SDSU conducting research on grassland bird habitat at multiple spatial scales including the effects of invasive grass and forb species on South Dakota grassland birds. Greer obtained his Ph.D. in Natural Resource Ecology and Management from Oklahoma State University. His doctoral research focused on invasive grass species from South Texas and the dreaded Old World Bluestems, which are problematic across the central and southern Great Plains.

Greer looks at grassland restoration in a different way than most – from the ground up. He will share with us his thoughts on soil microbes and allelopathic chemicals and their influence on plant-soil feedbacks which have the potential to alter the plant and animal community.



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## Sunday Plenary Speaker

**Glen Gillman, Park Land Manager, Travis County Parks, Austin, TX**
**Contact: glen.gillman@traviscountytx.gov**

Glen Gillman has been a member of the wildland fire management community in Texas for the past two decades. Gillman has worked for federal, state, county, city, and non-profit agencies in that time and has initiated multiple fire management programs including a private land prescribed fire initiative on the Coastal Plains and the first municipal wildland fire management program in the State of Texas. He has worked across the nation on all types of incidents including: wildfires, wildland fires for resource benefit, prescribed fires, and all risk incidents, but the majority of his experience is in prescribed fire implementation in Texas. He holds certifications from both the National Wildfire Coordinating Group and the Texas Prescribed Burning Board.

Gillman is currently the Park Land Manager for Travis County Parks. In this capacity, he is also responsible for the management of all non-park properties in Travis County including flood buy-out properties and new green belts currently being purchased. He developed and manages Travis County Parks' new fire management program and is responsible for general resource management across the whole park system, approximately 10,000 acres. As Gillman says, "We are just getting the fire program moving and picked up 4 burns totaling 650 acres this summer; a good start."

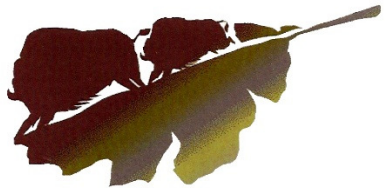
Gillman will be discussing his experiences in fire management in Texas over the past two decades, evaluating what has been accomplished, and what future challenges we may face in wildland fire management in the State.

# Presentation Abstracts

[alphabetical order by presenter's last name]



***Texas Yellow Star, Cont.***



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Abullah, Meshal
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**Restoration Planning for Degraded Arid Landscapes**

Intervention is often required for the restoration of damaged arid ecosystems, particularly when the base environmental conditions are no longer suitable for autogenic recovery. Umm Nigga, in the northeastern portion of Kuwait, was damaged by overgrazing and destructive camping, following de-mining operations that occurred shortly after the Iraq War in 1990/1991. For Umm Nigga, it is unclear whether its restoration will require remediation of the soil conditions, or whether autogenic succession can occur once the area is fenced and released from this pressure. Thus, the central objective of this study was to design a concept strategy that can help in selecting the required restoration actions. Our specific objectives were to assess the soil condition at the site, and to determine suitable locations for re-vegetation using GIS. We collected soil samples within each ecosystem and the vegetation was assessed using Braun-Blanquet cover-abundance scale. We also used GIS models to select locations for planting native species by seeds and seedlings.

Our results showed that the vegetation in the coastal portions of the ecosystem was not damaged. However, in the desert ecosystem locations, phosphorus, potassium, and organic matter were higher in the reference area soils, and correlated with the higher vegetation cover. We conclude that soil remediation and planting/seeding are likely not necessary to restore the damaged sites in any ecosystem type at Umm Nigga, given that each still contains sufficient concentrations of nutrients to support native desert plants that are adapted to these harsh conditions. We also conclude that the introduction of fencing will likely release the ecosystem from the grazing disturbance and allow autogenic recovery. With these sites as a model, a conceptual framework is presented for arid ecosystem assessment and restoration planning.

Alexander, Heather
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**Alleviation of Abiotic and Biotic Stressors to Improve Thornscrub Forest Restoration in South Texas**

Thornscrub forests occur throughout south Texas and northeastern Mexico and provide critical habitat for numerous fauna, including the Federally-endangered ocelot. However, little original thornscrub remains due to land conversion for human use. One approach underway to restore thornscrub habitat around core ocelot populations in south Texas is the planting of thornscrub seedlings in old agricultural fields. However, abiotic and biotic stressors such as drought, competition with invasive grasses, and herbivory often impede the restoration process. During the last four years, we performed three separate studies within the Laguna Atascosa National Wildlife Refuge in south Texas to determine thornscrub seedling survival and growth in response to several restoration strategies aimed at alleviating these stressors. Strategies, used singly and in combination, included pre-planting prescribed fire and mowing, various herbicides, herbivore exclosures, seedling shelter tubes, and different planting densities.

Overall, seedling shelter tubes improved thornscrub seedling height growth and survival at least during the first 1.5 years post-planting by reducing browse and improving microclimate around the seedling. Pre-planting fire, regular application of grass-specific herbicide, and herbivore exclosures also improved seedling growth and survival, but effects were most pronounced for seedlings in shelter tubes. Seedlings planted at high density (1 seedling per 0.25 $m^2$), especially in the absence of a shelter tube, often had better growth and survival than those planted at low density (1 seedling per 4 $m^2$). This study highlights the necessity of alleviating stressors in semi-arid thornscrub forests to improve habitat restoration success.



## ***Indiangrass, Cont.***


**Wild Mercury Preserve**
**Contact: David Davidson, San Antonio, TX**

## ***Texas Banded Gecko***

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***Indiangrass***

**HDR, Inc.**
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**Shield Ranch**
**Contact: Bob Ayres, Austin, TX**



Brush, Timothy
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**Use of Mature and Revegetated Woodlands by Breeding Birds in the Lower Rio Grande Valley of Texas.**

Revegetation of formerly wooded tracts in the Lower Rio Grande Valley has been going on since the 1980s, but its effectiveness at restoring woodlands bird communities has not been evaluated. We conducted point counts of breeding birds in such tracts in May-June 2013 and 2014. Many common breeding species, such as Olive Sparrow and Northern Cardinal, did not make a strong distinction between mature and revegetated habitat. Other species, like White-tipped Dove and Long-billed Thrasher were most regularly found in mature thorn-forest, with high canopy cover, good litter quality, and no significant grass invasion. Revegetation has had mixed success attracting species of conservation concern: Altamira Orioles and "Lomita" Carolina Wrens regularly used revegetated tracts, while Northern Beardless-Tyrannulets and Gray Hawks used reveg areas in small numbers. Although the goal of revegetation is to recreate forest or thornscrub habitat, Lesser Goldfinch, Verdin, Yellow-billed Cuckoo, and Buff-bellied Hummingbird used more open, younger revegetated tracts more than mature thorn-forest. Issues such as drought and flooding complicated our interpretation of the results, but it does appear that revegetation of thorn-forest has already accomplished the goal of creating woodland habitat for species characteristic of Tamaulipan thorn-forest. Tall riparian forest is extremely difficult to maintain or restore via revegetation, due to its higher moisture demands. Such areas, which could be used by nesting populations of Gray Hawks, Tropical Parulas, and Red-billed Pigeons, will require significant water management efforts to produce and maintain, except in low areas right along the Rio Grande or a moist resaca.

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**Large Scale Ecosystem Restoration - How we do it in Texas**

This presentation presents information on how Texas is building capacity for large scale restoration planning and project implementation at multiple scales and across various sectors. The overarching message is intergovernmental and stakeholder dialog and team work and how we build on years of restoration experience and apply it now to the RESTORE Act funding opportunities. Texas has a large coastal zone, multiple river and stream systems contributing to our six bays and estuaries pulling in large scale watersheds as opportunities important to ecosystem restoration. Further, we have the longest portion of the Gulf Intracoastal Waterway that has resulted in over 325 miles of restoration challenges with a majority of Texans not perceiving us as a coastal state. Key takeaways how Texas is preparing a comprehensive coast restoration master plan with realistic goals that involve community resiliency and ecosystem sustainability. Those who grapple with large scales, overlapping regulatory frameworks, and putting together partnerships and citizen awareness would be most interested in the content of this presentation. Case studies will be used to describe examples of large scale restoration projects and the mechanisms used to achieve them. The types of attendees who would most benefit would include communities and stakeholders that want to forge ecosystem restoration projects through partnerships across intergovernmental and non-governmental entities and practitioners and agency managers interested in planning and finding the funding sources to undertake large scale and long range restoration projects.



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**Techniques for Restoring Incised and Eroded Stream Channels**

The ability to decrease the velocity of water allows for sediment deposition, vegetation establishment, and infiltration of water into the underlying aquifer. As sediment loads become deposited, seeds germinate and roots from vegetation become established; therefore, eroding soils begin to stabilize. Our objective was to restore plant community function to a riparian zone along a damaged reach of stream channel. In May of 2014 we treated 22,000 feet of stream channel in the western portion of south Texas near Carrizo Springs. In total, we built 30 1-rock dams, 15 filter dams, 8 plug and spread structures, 5 earthen dam/spillways, and 10 media lunas. Restoration within the stream channel was initiated primarily with plug and spread structures, which helped to divert water out of the incised stream channel onto the abandoned floodplain via small bays. We supplemented areas along the stream channel with 1-rock and filter dams, which helped to raise the stream channel by trapping sediment and growing vegetation. Earthen dams were used to slow and pool water within the stream channel at various intervals, while also allowing water to flow downstream to aid in restoration. We are continuing to monitor long term vegetation response in the stream channel and throughout the natural flood plain; however, short term vegetation response along and throughout the stream channel has been significant. In February of 2015, we initiated Phase II of this project, treating an additional 3,500’ of stream channel.

Davidson, David
Wild Mercury Preserve, Kendall County, TX
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**KR Bluestem: Restoration to Native Grasses and Forbs**

A procedure has evolved over the past 8 years for replacement of this invasive grass by native grasses and forbs. KR bluestem was killed beneath burned brush piles, and these areas were reseeded. To date 15 burn scars have been restored. Solarization is also being used to kill KR bluestem, followed by reseeding - 3 plots so far. The metrics used to evaluate and guide the restoration process are (1) photographic record, (2) measurement of soil biotics (bacteria, fungi, protozoa, nematodes, and mycorrhiza), and (3) phospholipid fatty acid analysis (PLFA) of soils. The metrics indicate that so far the restoration procedure is effective. Heating the soil is apparently necessary to inhibit or kill the factor that is causing KR bluestem to be allelopathic. Fusarium sp. and Rhizoctonia sp. pathogenic fungi are associated with KR bluestem, and the current hypothesis is that this is the factor that is denatured by heat, thereby allowing successful restoration Efforts to examine this hypothesis are on-going.



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Eddy, Kevin

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### *Coreopsis tinctoria* Avoids Competition with a $C_4$ Grass Through Temporal Gaps

*Coreopsis tinctoria* (Asteraceae) is a widely-distributed, North American prairie annual that flowers in early spring through early summer. We hypothesized that *C. tinctoria* uses temporal gaps to avoid interspecific competition with $C_4$ grasses. It was grown with *Bouteloua curtipendula* (Poaceae), a $C_4$ grass, in simulated temporal gap experiments conducted at The University of Texas at San Antonio (29°35' N, 98°37' W). *Coreopsis tinctoria* and *B. curtipendula* were planted in a de Wit replacement series, but varying the time between planting each species. *Coreopsis tinctoria* was planted 60 days before *B. curtipendula* (+60), 30 days before (+30), at the same time (+0), 30 days after (-30), and 60 days after (-60). We found significant species x gap x frequency ratio interaction, and significant gap x frequency ratio interactions for both species. In +60, *C. tinctoria* produced the greatest total dry mass per pot at each frequency ratio, and produced greater total dry mass in frequency ratio 10:2 rather than 12:0, indicating intraspecific competition. Total dry mass per plant of both species decreased as the frequency of that species increased, also indicating intraspecific competition. *Coreopsis tinctoria* mass was further reduced when *B. curtipendula* was present, indicating interspecific competition. *Coreopsis tinctoria* appears to avoid interspecific competition when given a temporal growth advantage, suggesting that *C. tinctoria* avoids competition by establishing in temporal gaps that exist before environmental conditions favor growth of *B. curtipendula*.

England, Angela
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City of Austin, Watershed Protection Department, Austin, TX
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**Restoring Carbon Sequestration in Austin Riparian Zones**

Riparian forests provide a variety of ecological functions such as improving water quality and quantity, stabilizing stream banks and reducing flood damage, providing aquatic and terrestrial habitat, and reducing the impact of climate change by sequestering atmospheric carbon. Unfortunately, in urban areas, many riparian forests have been damaged or lost. The Watershed Protection Department of the City of Austin uses a combination of passive and active restoration approaches to increase urban riparian forest cover on protected public lands known as Grow Zones. Many degraded areas are now recovering from decades of mowing and other disturbances, though other areas are relatively less impacted and may serve as a reference against which progress may be measured. In spring, 2015, we surveyed all sapling and mature native trees and shrubs in 35 reference and 37 degraded plots. We then used formulas from the USFS Forest Inventory Analysis to quantify the number of trees, number of species, and amount of carbon stored in 100-$m^2$ plots. As expected, reference plots had more trees, greater numbers of species, and more carbon biomass than degraded plots.



Williams, Casey
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**Restoration of Native Submersed Aquatic Macrophytes for an Endangered Fish Species**

The Comal Springs and Comal River is a short urban river (3 km) located entirely within the city of New Braunfels, Texas, U.S.A. The Comal River is fed by the Comal Springs a karstic spring system that produces an historical average of 280cfs in flow. As many as seven rare and endemic spring or riverine species are found in the Comal system with six species listed as threatened or endangered by the United States Fish and Wildlife Service (USFWS). To help better protect these endangered species the USFWS approved a Habitat Conservation Plan to be implemented by the City of New Braunfels and other stakeholders which identifies several goals to improve and increase habitat for target species. One such target species is the fountain darter, *Etheostoma fonticola*. To improve habitat for this fish species several projects were implemented in the Comal River. These include removal of *Hygrophila polysperma*, a dominant nonnative submersed macrophyte, as well as propagation and reintroduction of native aquatic submersed macrophytes such as *Ludwigia repens Cabomba caroliniana* and *Sagittaria platyphylla.* Monitoring data collected over the previous fifteen years indicates that fountain darter densities are typically higher in these native macrophytes than *Hygrophila polysperma*. Location of restored area was prioritized based on historical observations and data collection of native macrophyte distribution, sediment and channel characteristics and water quality requirements for the fountain darter. In order to provide a reliable source of native aquatic plants several techniques were used including sprigging of stem fragments and *in situ* nursery propagation. Removal of *Hygrophila polysperma* and reintroduction of native vegetation in prioritized locations is expected to benefit the fountain darter by improving the quality of habitat, potentially resulting in higher fountain darter densities in these areas. Since 2013 an estimated 4,000 m² of *Hygrophila polysperma* have been removed and over 20,000 native aquatic macrophytes have been planted covering an estimated 3,100 m².

Shackelford, Colin
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**Evaluation and Development of Native Seed Sources for West Texas**

The West Texas Native Plant Materials Initiative was organized under the *Texas Native Seeds* Project of the Caesar Kleberg Wildlife Research Institute at Texas A&M Kingsville in 2010 as a partnership with the Borderlands Research Institute at Sul Ross State University.

Our mission is to develop native ecotypic seed sources for restoration activities in the Trans Pecos, western Edwards Plateau, and adjacent ecoregions. At present, only one high quality, locally-adapted native seed source appropriate for use in these regions is commercially available. Our goal over the next decade is to develop 15+ regionally-adapted ecotypic seed sources for restoration work in West Texas.

Over 835 collections have been made from a target list of 38 grasses and 52 forbs across 37 counties in West Texas. These collections are the foundation for the evaluation and selection of ecotypic native plant materials for commercial scale production.

Presently, 16 species are in initial and advanced evaluation as well as the project feasibility stage of development. Eight species under evaluation have an expected commercial release date of late 2016. Evaluation plantings are located at two sites representative of the variable climate and soil environments of the Trans Pecos, western Edwards Plateau, southern Rolling Plains, and southern High Plains ecoregions of West Texas: the Sierra la Rana Plant Research Facility, south of Alpine, TX; and the Railway Ranch Plant Research Facility, south of Odessa, TX.



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**Using GIS to Develop Priority Areas for the Restoration of Eastern Wild Turkeys in Texas**

Despite restoration efforts dating back to the late 1970's, populations of Eastern wild turkey (*Meleagris gallopavo silvestris*) in Texas have consistently remained low and fragmented. In 2007, Texas Parks and Wildlife Department (TPWD) funded research through Stephen F. Austin State University to test a super stocking model for restoring turkey populations, which showed promising results. Recently, TPWD reopened the Eastern wild turkey restoration program with a goal to restore wild turkeys to large tracks of suitable habitat utilizing this super stocking approach. TPWD staff constructed a landscape scale Habitat Suitability Index (HSI) as a tool to assist in restoration efforts. The HSI was developed to evaluate spatial data representing the environmental conditions that are favorable to Eastern wild turkey. The HSI evaluates Eastern wild turkey habitat based on 4 criteria: 1) Edge habitat, 2) Human Disturbance, 3) Land Use/Land Cover, and 4) Riparian Corridors. The habitat criteria input values were reclassified and normalized into raster layers with 10m resolution. Composite HSI scores were then calculated from those input rasters to show spatial ranking of suitable habitat. Further analysis was conducted to statistically identify focal areas of relatively high concentration of potentially suitable habitat for future restoration efforts and management.

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**Fish Assemblage Structure Indicates Limited Progress in Restoration Process Over a Lustrum in a Severely Degraded Estuary of Southern Tamaulipas, Mexico**

An increase in intensity and frequency of human derived stressors on estuaries worldwide continues in spite of the high-valued ecosystem services they provide. Restoration efforts are nowadays common, but ecosystem recovery may be long and costly. In southern Tamaulipas, the Garrapatas Estuary (GE) was deprived of tidal influence for over two decades, and has two sections partially separated by a bank. After marine water inflow was restored at high cost, the fishes assemblage was documented for five consecutive years and compared to a nearby reference estuary. After this lustrum only four out of 15 species recorded in the reference site have returned to the restoring estuary. Furthermore, five oligo or mesohaline species were still found in GE, possibly as disturbance legacy. Assemblages changed less (species richness, diversity, evenness) in the last four years, potentially indicating stabilization without full recovery. One invasive species (*Oreochromis aureus* (Steindachner, 1864)) dominated the community in one of the assessed sections of the GE. Assemblage similarity percentage was 42% between reference and restoring systems. Salinity and dissolved oxygen were the main drivers of variation among sites. Overall, the resalinization of the estuary which produced rapid and drastic changes in the riparian plant community, was followed by a slow and partial recomposition of the fishes assemblage. The present study calls for an assessment of adult individuals to avoid confounding factors known to vary ontogenetically in fishes (*i.e*. salinity), which combined with an evaluation of ecosystem function could allow better testing of recovery or stabilization in GE.



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**Operationalizing Resilience in a Shrub-Encroached Semi-Arid Rangeland Ecosystem: A New Opportunity for Ecological Restoration**

The utility of the resilience concept in restoration ecology has been limited by difficulties in quantifying thresholds associated with management actions and ecosystem transformability. In the context of shrub-encroached rangelands, resilience can be defined as the capacity of a woody-vegetated state to absorb management interventions designed to produce more desirable grass-dominated states. Consequently, we suggest that differences in resilience can be quantified in a relative sense by measuring whether a degraded state switches to an alternate state following restoration intervention. We repeated chemical, mechanical and pyric brush management treatments across a gradient of soils in a degraded South Texas rangeland to assess the relative resilience of shrublands occurring on different soil types. Our results show that an ecosystems capacity to recover from brush removal treatments depended on soil type. Shrubland resilience was highest on coarse-sandy soils where brush removal temporarily restored herbaceous dominance, but woody plants quickly regained pretreatment levels of dominance. However, shrublands on clay soils did not recover following brush removal treatments and continued to be grass-dominated for the duration of the study. This simple approach for prioritizing restoration actions by mapping the locations and extent of different soil attributes that support shrub-dominated states with differing levels of resilience to brush control should prove useful to restoration practitioners by providing a basis for operationalizing resilience in restoration. Increased efficiency and efficacy through the prioritization of management actions across a range of environmental conditions is critical given the economic constraints associated with broad-scale restoration interventions for degraded rangeland ecosystems.

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**Proposing Citizen-Based Restoration in an Urban East Texas Forest Preserve**

This poster describes a proposal and initial efforts to involve local citizens in restoring and monitoring an urban, riparian forest habitat in East Texas. Banita Creek Preserve, located in Nacogdoches, Texas, is managed and owned by the Texas Land Conservancy based in Austin. Students in two previous offerings of a biogeography class set up and measured vegetation transects in the Preserve. Stream health was also measured, while stand history was determined using county records. Students in the Sustainable Community Development program are now developing a plan for hands-on citizen restoration activities, beginning by removal of selected non-native invasive species such as Chinese privet and Japanese honeysuckle. Considerations of restoration include factors such as lower historical fire frequency in riparian settings, current landscape context of understory songbird habitat, and the community benefits of involving diverse local housing complexes in actively learning ESL (Ecology as a Second Language).



Grace, Joshua L.
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**Changes in Soil Microbial Community and Structure Along a Tanglehead (*Heteropogon contortus*) Density Gradient in South Texas**

Invasive grasses are becoming a top concern of wildlife and range managers throughout south Texas. Invasive species can have detrimental effects on vegetation community composition and diversity, as well as wildlife habitat quality. There is increasing evidence invasive grasses affect ecosystem processes such as energy and nutrient cycling and soil microbial processes. Tanglehead (*Heteropogon contortus* [L.] P. Beauv. *ex* Roem & Schult.) is a warm season, perennial bunch grass rapidly increasing throughout the Texas Coastal Sandsheet of south Texas. To examine the effects of tanglehead invasion on microbial soil processes we evaluated microbial community size and structure in three different vegetation community types representing a tanglehead invasion gradient including 1) native plant community, 2) tanglehead-native mixture, and 3) tanglehead dominant in 2013, 2014, and 2015. Soil microbial communities were evaluated for microbial biomass C (MBC) and N (MBN) and community structure via FAME profiles. Treatment and year interacted in their effects on microbial biomass. Soil MBC was greater in sites with less tanglehead abundance in 2013 and 2015; MBN was also greater in sites in sites with less tanglehead in 2013. Multivariate analyses and nonmetric multidimensional scaling ordination reveal trends in microbial community composition. Microbial community size fluctuated less over time in tanglehead sites than native sites, and there are potential changes in soil quality and microbial functioning in tanglehead-dominated ecosystems. This research will help to determine the extent of these effects on wildlife habitat, and how to more efficiently focus habitat management and restoration efforts in south Texas.

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**Fuel Management at the Wildland Urban Interface (WUI): Field Notes from the Water Quality Protection Lands of Austin, Including Review of an Air Curtain Incinerator (ACI) for On-Site Biomass Disposal**

Austin Water and Austin Fire Department have partnered to create perimeter access corridors and shaded fuel breaks to reduce the risk of fire spread between natural and urban areas. Ecological and operational elements of various methods are discussed, and a mobile incinerator that captures particulates is highlighted as a tool that may be useful to land managers where smoke management is a concern.



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**Comparison of Seasonal Prescribed Burning on Coastal Cordgrass Vegetative Communities**

When gulf cordgrass (*Spartina spartinae*) and marshhay cordgrasses (*Spartina patens*) remain undisturbed and mature, their nutritional value declines, creating less diverse and desirable food and cover for wildlife. In this study, prescribed fire will be applied to large cordgrass areas to remove decadent cordgrass growth and encourage forb production. Our objectives are to (1) compare effects of fall and spring burns on gulf cordgrass production and nutritional content; (2) determine how cordgrass individuals respond to different seasons of burning ; (3) determine the effect of prescribed fire on plant diversity within cordgrass communities; (4) determine the length of improvement in vegetation nutrition and compositional change for each season; and (5) develop prescribed burning recommendations along the Gulf Coast Prairie to maximize plant diversity and wildlife habitat improvement on a sustainable basis.

Our study is being conducted on the East Foundation's El Sauz property in Willacy County. The study site consists of 10 plots (roughly 500 acres each); two independent plots will be burned each fall and spring for a total of 8 treatment plots and 2 control plots. Placed in each plot are two 60 m transects for sampling cordgrass and the adjacent vegetation community. Cordgrass forage samples will be analyzed before and after each burn for several weeks to determine nutrient variations and fluctuations. Cover will be measured using SamplePoint software which analyses foliar cover using digital imagery.

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## Vegetation Surveys Corroborate the State and Transition Model of Three Ecological Sites at Peri-Urban Abandoned Cropland in South Bexar County Texas

Ecological sites are defined by plant community dynamics, soil composition, climate, and topographic features. Ecological site descriptions provide information on the current vegetative and successional stages of a community, which could be used for land conservation and wild life management. This is particularly true for areas that are no longer grazed or farmed in rural or peri-urban areas. In this study we assessed the provisional ecological site description and state-and-transition model for three Ecological sites located in 600 acres of peri-urban abandoned land on South San Antonio. For this study we identified three ecological sites based on soil types and prevalent plant associations. To determine the successional stage of each ecological site we used a 50m transects. To determine changes in plant cover and species composition we conducted a line-point intercept. To determine plant production we established a 5x5 quadrat at 0m, 25m and 50m point, and for each quadrat we randomly placed a Daubenmire three times and clipped the above ground vegetation. The Ecological sites described were Sunev clay loam, Willacy sandy loam, and Blackland clay loam. All are converted land communities that have not experienced grazing or fire disturbance for at least 4 years. Vegetative communities include Mixed-Grass/Mixed-Brush, midgrass and shrublands. Native and exotic species composition and production did not differ significantly between the current study and the provisional ecological site description for these three Ecological sites. This study validates the current transition state models for expected vegetation composition and production for the three Ecological sites.



Henehan, Anthony
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## Population Response of Wintering and Breeding Songbirds to Large-Scale Ongoing Grassland Restoration

Grassland birds have recently exhibited drastic population declines. Non-native grasses such as buffelgrass (*Pennisetum ciliare*) have spread throughout the southwestern United States, degrading wildlife habitat through the formation of monotypic stands. Current grassland restoration efforts have focused on small-scale (<5–ha) plots, with few to none focusing on buffelgrass. In January 2014, we initiated a large-scale (118–ha) grassland restoration of a buffelgrass-dominated area to determine the effects of restoration on non-game birds, game birds, small mammals, and pollinators while restoration is ongoing. Our study was located in La Salle County, Texas. We monitored densities of wintering and breeding birds on 3 areas: 1) an unaltered native shrub-land (117–ha control), 2) non-native grassland (109–ha control), and 3) an area currently being restored to native vegetation (118–ha treatment). We conducted point-counts during winter (Dec–Jan) and summer (Jun–Jul) of 2014 and 2015. Pre-treatment wintering bird densities were 265% greater on the treatment area (18.19±4.28 $ha^{-1}$) than the native area (6.86±1.13 $ha^{-1}$), and 114% greater on the treatment area than the non-native area (15.89±4.24 $ha^{-1}$). Winter bird densities dropped by 500% on the treatment area (3.59 ±1.22 $ha^{-1}$) during restoration. Summer bird results show densities 229% greater on the native area (16.27±1.94 $ha^{-1}$) than the treatment area (5.45±2.09 $ha^{-1}$), and 165% greater on the native area than the non-native area (9.84±1.89 $ha^{-1}$). Understanding the responses of the different avian assemblages that utilize grasslands will help land managers and biologists effectively manage this declining guild.

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**Bicarbonate Utilization Potential of Submersed Aquatic Vegetation and Its Implications for Native Plant Restoration in a Spring-Fed Central Texas River**

Macrophyte-dominated spring-fed streams are unique freshwater ecosystems that provide habitat for many endangered species. These ecosystems are threatened by anthropogenic and climatic factors which cause degradation and the depletion their aquiferial sources, the effects of which are not well understood. One primary concern is the ability of restored aquatic plant communities to persist as water chemistry is altered by reduced or discontinued spring flow. In particular, changes in pH affect the dissolved inorganic carbon (DIC) available for use by submerged aquatic vegetation (SAV). As stagnation occurs, pH increases and concentrations of dissolved $CO_2$ decrease, causing the predominant DIC species to shift to bicarbonate ($HCO_3^-$). The extent to which SAV can utilize bicarbonate determines the likelihood that the species will persevere under low-flow conditions. We tested the bicarbonate utilization potential of native and non-native SAV in the Comal River, TX, using the pH drift method. We found that some native species which provide habitat for endangered fountain darters are incapable of utilizing bicarbonate while others readily utilize bicarbonate or can be induced to do so. Our findings have implications for which native plants should be selected for use in ecological restoration projects and suggest a likely shift in SAV community composition under some projected flow conditions.



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**Solarization: A Restoration Tool**

Solar blankets are being used to kill KR bluestem by using incident solar energy to heat the soil as the first step to native grass and forb restoration. Instrumented solarizations (soil temperature at several depths, moisture, and incident solar flux) over the past two years have identified the factors involved in soil heating that are important for the process to be effective, including the design of the solar blanket. The sun-to-soil energy transfer process is been modeled in an attempt to incorporate partly cloudy days. The time-temperature-soil depth profile has been determined and compared to the known requirements to kill grass roots and pathogenic fungi that may cause KR bluestem allelopathy.

# Posters Abstracts

[alphabetical order by presenter's last name]



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**Restoration Implications of Differential Responses to Interspecific Competition and Physiological Stressors for Native and Non-Native Submersed Aquatic Vegetation in Spring-Fed Central Texas Rivers**

Macrophyte-dominated spring-fed streams are unique freshwater ecosystems that provide habitat for many endangered species. These ecosystems are threatened by anthropogenic and climatic factors which cause degradation and the depletion their aquiferial sources, the effects of which are not well understood. Of primary concern is the ability of restored aquatic plant communities to persist when confronted with competition from non-native species and alterations in water chemistry induced by low-flow conditions. Non-native submerged aquatic vegetation (SAV) can have devastating effects when they are able to exploit resources and overtake new environments, causing niche disruption. Additionally, SAV species have differential physiological tolerance ranges with respect to changes in temperature and pH. Temperature affects the enzymatic processes involved in photosynthetic carbon assimilation while pH affects the available forms of dissolved inorganic carbon (DIC). As stagnation occurs, temperature and pH increase, causing potential disruptions in enzymatic reactions and a shift in DIC composition from $CO_2$ to bicarbonate ($HCO_3^-$), which many species are unable to utilize. A combination of in-situ, mesocosm and laboratory experiments were used to address the responses of native and non-native SAV species from the Comal and San Marcos Rivers to competition and increases in temperature and pH. We found that one native species fared well across all categories while others showed weakness in one or more areas. Our findings have implications for which native plants should be selected for use in restoration projects and suggest a likely shift in SAV community composition under some projected flow conditions.

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**Small-Scale Land Restoration – A Case Study**

Rural areas southwest of Austin have typically been severely degraded by ranching practices over the past 100 years or so. Now housing tracts are developing at a rapid pace, replacing ranches with suburban neighborhoods and accompanying landscapes of exotic plants. Older developments with larger lots (> 1 acre) represent an opportunity to create small, restored landscapes to patch together and provide native habitat. This presentation documents the 15 year restoration process of a two acre parcel of land in an older Dripping Springs development in the Balcones Canyonland ecoregion. The restoration of three restored habitats is provided – prairie, woodland, and waterway (wet weather creek). Small scale land restoration techniques and processes will be described.



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**Utilizing Biological Monitoring and designed Experiments to Guide the Implementation of an Aquatic Plant Restoration Project: The Comal River Experience.**

Many restoration projects are implemented with little or no information to provide guidance as to how the restoration project should be carried out. Rarely are historical or baseline data available to provide insight on the structure and function of the site before impairment greatly decreasing the chance of success especially at the ecosystem scale of restoration. Additionally few restoration projects are provided the opportunity and structure to conduct parallel designed experiments in order to answer questions regarding the long-term success of the project. In 2013 a large scale aquatic plant restoration project was begun to help improve and increase habitat for a small endangered fish species living in the Comal River in New Braunfels, Texas. The project involves removing an invasive aquatic plant by mechanical means and re-introducing native aquatic plants. To answer crucial questions such as which native plant species to use, locations to restore and to help inform the potential of overall success available data such as past biological monitoring programs and historical vegetation mapping were consulted. In addition several designed experiments were instituted to help provide knowledge as to the short term and long term success of the project. These designed experiments looked at the tolerance of native aquatic plants to warm water temperature, how selected macrophyte species utilize available carbon and competition experiments among others. Utilizing biological monitoring and designed experiments should greatly enhance the long-term success and management of this restoration project.

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**Effects of Shrub Encroachment and Shrub Removal on South Texas Coastal Prairies**

Native-invasive shrubs honey mesquite (*Prosopis glandulosa*) and huisache (*Acacia farnesiana*) are aggressively encroaching onto South Texas coastal prairies, outcompeting Gulf cordgrass (*Spartina spartinae*) and associated prairie vegetation with potential legacy effects on the landscape. This shift from prairie to inhospitable shrubland has significant implications for local disturbance regimes, erosion and fauna such as the federally-endangered aplomado falcon (*Falco femoralis*). To evaluate the interaction between grass and shrubs, data loggers were installed for 16 mos in shrub understories and grass cover to monitor light, soil and air temperatures. Understory vegetation and canopy surveys were also conducted to evaluate grass cover in the presence shrubs. Data show slight differences between shrub understory and grass cover microclimates, and that higher shrub cover generally leads to lower grass cover. The second part of this study examined the regrowth of grass in small, medium and large bare patches left after shrubs were removed by U.S. Fish and Wildlife Service using the following methods singly or in combination: mechanical, prescribed fire and herbicide. Results after 1 yr of sampling show growth rates in large bare patches treated with all three removal treatments were at least 2.36% per month higher than areas treated without fire. After 16 mos, these same patches had at least 8.71% fewer mesquite and huisache shrubs than areas only treated mechanically, indicating all three removal treatments used together promote the most efficient means for coastal prairie rehabilitation by reducing shrub resiliency and the amount of time needed for natural prairie revegetation.



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**Potential Trade Offs of Regulating and Cultural Ecosystem Services in Urban Areas of the Lower Rio Grande Valley, Texas**

Urban environments present a unique set of challenges to the maintenance or restoration of ecosystem services, where there are often tradeoffs between certain regulating ecosystem services that typically operate at a relatively large scale (such as storm water retention, carbon sequestration, and energy savings) with cultural ecosystem services (such as aesthetics and other values) that often drive urban landscapes, especially at the urban/suburban household unit. This is especially apparent in the fastest urbanizing area in the state, the Lower Rio Grande Valley, which has grown nearly 45% in population each decade for the past 20 years, and where only 5% of natural areas remain. In this area, we compare remotely sensed tree cover data with average home values estimated using a hedonic pricing method to test our hypothesis of a positive association between urban tree cover (as a proxy for regulating services in urban areas) and home value (as a proxy for aesthetics). We also examine whether urban tree cover can predict other associated cultural services, such as early elementary school performance. Understanding this dynamic between urban ecosystem services is paramount to helping city managers best encourage homeowners to manage urban landscapes that best maximize the conservation of services that are most salient to these areas.

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**Assessing Ecosystem Health in Restoring and Unrestored Resacas of the Lower Rio Grande**

As the only freshwater wetlands in the lower Rio Grande Valley aside from the Rio Grande River, resacas are a key habitat component for many plant and animal species. Resacas are distributaries that were once conveyance routes when the Rio Grande flooded. Current management involves pumping water from the river into the resacas. Agriculture and urbanization have derived in sedimentation, habitat loss, contaminants, poor water quality and invasive species. The City of Brownsville has undertaken a multiyear effort to restore aquatic habitat quality through removal of sediment and debris in several resacas. Objectives of the assessment and monitoring project include recording bimonthly water quality parameters and biological data, used to develop a habitat health index for routine assessments in the future. An integral part of this data collection is a school based monitoring network titled “Resaca Rangers” implemented this year, which also educate students on the importance resacas and enhance public awareness. The biological data is intended as ecological indicator metrics, which are being tested for incorporation into the health index. Accuracy, redundancy and/or inadequacy are being determined for decomposition rates, trophic state index based on chlorophyll ‘a’, benthic and fish community metrics, and riparian and bank condition. Comparative results on these ecological indicators will be discussed for restoring, degraded and well preserved resacas.



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**Trickle Channel Resurrection: A Wetland and Stream Restoration in Urban Austin**

Born out of a review of City of Austin properties to identify opportunities to improve water quality, this location had the advantage of a perennial spring in the headwater of a heavily urbanized creek, wetland vegetation and lots of space. By removing more than 500 feet of concrete trickle channel this project recreated surface/groundwater contact, added stormwater treatment, and activated a headwater floodplain. This project includes differing levels of restoration/rehabilitation spanning from passive succession to major channel work followed by intensive native plantings. This case study will review lessons learned in design, construction, and maintenance, as well as assessment of the ecological and water quality values the project has resulted in.

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**Season of Prescribed Burning on Kleberg Bluestem (*Dichanthium annulatum*) in South Texas**

Kleberg bluestem (*Dichanthium annulatum*), a warm-season perennial bunchgrass is native to both the Asian and African continents, was introduced to South Texas during the 1930s. Its subsequent invasion of the region has greatly impacted native plant communities and the wildlife that inhabit them. We conducted a season of burning study to evaluate the use of prescribed burning as a control method for Kleberg bluestem. We investigated effects of both summer and winter burning on individual, as well as community-level metrics to better understand the initial impact of the fire treatments. Early results from the first year of burning indicated that summer burning can produce higher mortality rates in Kleberg bluestem than both winter burning and control treatments. However, both burning treatments increased seedling recruitment over control treatments, although we have not had sufficient time to determine whether recruits will become established successfully. Burning in either summer or winter did not affect individual plant production. These early results indicate neither summer nor winter burning is effective for short-term control of Kleberg bluestem as a single treatment, although summer burning is a better choice than winter burning. Treatments will be repeated in future years to investigate the long-term effects of repeat treatments.



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**Forb and Woody Species Restoration in the Texas Hill Country: A Sequential Approach**

Restoration of Texas Hill Country landscapes frequently starts with an attempt to replace dominant invasive grasses with palatable native grasses that have been reduced or eliminated through cattle grazing. However, successful reestablishment of palatable woody and perennial forb species, long ago degraded by goat browsing and unable to recover under high white-tailed deer populations, is a more difficult and long-range project.

Environmental Survey Consulting has developed a restoration process model for Spicewood Ranch and other projects over the past three decades. The model emphasizes restoration of depleted browse species through a combination of reduction of deer population while incrementally increasing available browse. We are developing a planting sequence of browse species based on their palatability and, therefore, their ability to survive when introduced over years in synchrony with gradual reduction of browse pressure. We have developed this sequence through numerous experiments and field trials using controlled burns, cedar removal, deer reduction, high fencing, wild seed harvesting, seeding, exotic species control, woody plant germination trials and deer exclosures. An evolving list of 150 forbs and woody species guides our site analyses of deer browse levels, restoration reintroduction attempts and landscape plantings.

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**Improving Ecological Functions with Rain Gardens**

The San Antonio River Authority (SARA) promotes sustainable landscape practices such as rain gardens in order to achieve improved ecological functions. Rain gardens can support ecological services including improvements to water quality, conservation of native species biodiversity and provision of wildlife habitat. SARA has designed and constructed multiple rain gardens to serve as best management practices demonstration sites to assist with education and outreach for the community. Each rain garden has been designed to meet the unique conditions of the sites which vary in terms of light exposure, soil type, desired treatment volumes and water source. The gardens also represent a variety of design styles, though all are intended to function well with little maintenance required. The various rain gardens will be discussed including lessons learned and adaptive management approaches implemented.



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**Journal Review Groups: Why Is Your Work Area Not Doing This?**

When you finished school you left with a certain amount of knowledge, skills and abilities, but the world keeps changing, research keeps moving forward and the hot topics of today may not be the same ones as were hot back in the day. It is easy to lose track of the current research, evolving practices and questions that were once what shaped your perspective. Going to conferences and staying up on journals is certainly one way to address this. But not all of us can and even if you can, not everyone from your work group can. Journal Review groups are a great way to supplement the experience of your group, keep everyone more up to speed and allow some knowledge transfer that does not follow the hierarchy of your work team. Further, they can help build social networks outside of your work group (if the journal review group is open to non-employees), transfer knowledge within (and from outside) the group and improve social and speaking skills of participants, all while staying current on the research/methods/topics of the day. Such groups are common in the field of medicine and should be more common in the natural science fields as well.

We will follow up with a somewhat abbreviate journal review session. Copies of the journal article will be made available for those who wish to participate.

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**Restoration of Ecosystem Services on Organic Agricultural Landscapes in South Texas with the Use of Cover Crops**

Ecological services derived from organic farming include soil formation, stabilization and conditioning, waste cycling, carbon sequestration, nutrient cycling, predation, pollination and habitat restoration. The Rio Grande Valley (RGV) in South Texas has converted nearly all of its land to agricultural production and urbanization. Changes of the size, arrangement, and quality of natural habitats are a fundamental challenge of natural resource management. When the majority of a landscape is made up of non-native ecosystems, techniques need to be developed to enhance ecosystem services on human managed ecosystems. Use of cover crops on otherwise fallow lands have shown to enhance ecosystem services such as: attracting native beneficial insects (pollinators), increase nutrient availability in topsoil, prevent nutrient leaching, increase soil organic matter, and reduces soil erosion. Cover crops are used in agriculture systems as ground cover, mulches, green manure and forage and food for animals and humans. In this study, four cover crops (Lab lab, Sudan Grass, Sunn Hemp, and Pearl Millet) were analyzed in the subtropical region of south Texas to see how their multiple functions enhance ecosystem services. The four cover crops were assessed to see their potential to harbor native insects, their potential to increase soil nitrogen, to increase soil organic matter, and to suppress weeds. The preliminary results suggest that these subtropical varieties of cover crops have potential to enhance ecosystem services on agricultural land in the RGV by increasing soil organic matter (in all varieties), increasing nitrogen in topsoil (Lab lab, Sunn Hemp), and reducing weeds (Sudan Grass).



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**Evaluating the Efficacy of Management Techniques (Mowing, Burning, and Herbiciding) on the Control of Cattail (*Typha* spp.) Across a Gradient of Nitrogen Loading**

In the Great Lakes Region, invasive wetland plants are often managed using fire, herbicide, mowing, or a combination of these, but long-term effectiveness across a range of exogenous N inputs is not well known. MONDRIAN is an individual based model, simulating growth and competition for nutrients and light among individual ramets; N cycling both drives, and is driven by, plant growth, litter production, and biogeochemistry of litter and sediment organic matter. We modeled the effectiveness of burning, mowing, and herbiciding on controlling *Typha* x*glauca* ten years after invasion of a 3-species native community across a N loading gradient (4 to 30 g N $m^{-2}$ $yr^{-1}$). Management lasted 1, 3, or 6 continuous years. Before management techniques were implemented, *Typha* was unsuccessful at low N loading, but formed monotypic stands at high N. For all treatments, the effectiveness of management depended on N loading. Herbiciding alone reduced invader biomass more than burning or mowing alone in eutrophic wetlands. When treatments were combined, herbicide+burning resulted in the greatest decrease in invader success across the N loading gradient (up to 80% decrease in invader NPP at high N loading). Overall, three years of management was often better than one year, though six years was seldom more effective than three years. At low N loading, some management techniques (e.g., herbiciding) actually benefited invasives likely due to N pulses associated with litter decomposition from tissue death. These simulations strongly suggest that to control *Typha* invasion a combination of both herbiciding and burning is required, especially at high N loading where *Typha* is most successful.

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**Science Can't Tell Me What To Do: The Limitations of Science and the Necessity of Emotion in Decision Making**

Restoration ecologists and land managers are often trained as scientists. They may even conduct or participate in independent research and publish in peer-reviewed journals, but their professional practice ultimately requires the use of science as well as other information to make sound management decisions. One factor that complicates the decision-making process is uncertainty inherent in natural systems. We use science to reduce this uncertainty, but a false assumption is that science can eliminate this uncertainty and make decisions for us. Thought processes such as intuition and emotion are required for decision-making but are often discounted as qualitative or unverifiable. This reinforces the popular belief that a perfectly logical, Mr. Spock-type mind is the optimal decision-maker. However, science itself has begun to reveal its own limitations to decision-making and to shed light on the powerful black boxes of intuition and emotion.

This talk will review some of the basic research into the roles of logic and emotion in decision making, discuss examples of how these processes have driven restoration decisions on the City of Austin Water Quality Protection Lands, and offer simple recommendations for pairing logic and emotion to make more sound decisions in the face of ever-present uncertainty.



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**Monitoring Old World Bluestem (*Bothriochloa ischaemum*) Invasion as Part of the Global Invaders Impact Network (GIIN)**

Invasive plants are present in ecosystems throughout the world, but research on their impacts has thus far been focused primarily on single species and results may not be directly comparable among studies. The Global Invaders Impact Network (GIIN) is a global effort to collect data about the impacts of invasive plants in a standardized way. Plots are scaled to the size of the invasive plant (e.g., bigger plots for trees compared to grasses). Data are collected in invaded and uninvaded plots, as well as in plots where the focal species has been removed. Removals are maintained for multiple years to understand legacy effects. A standard set of measurements is collected, allowing for comparisons among different sites and syntheses of different species. I will present an overview of the data collection methods, as well as preliminary (one year) data collected at the Barton Creek Habitat Preserve (Travis County).

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**Status of the Stout Iguana (*Cyclura pinguis*), A Restored Species, on Guana Island, British Virgin Islands**

The stout iguana (*Cyclura pinguis*) is one of nine species of West Indian rock iguana that collectively are recognized as the most endangered group of lizards in the world. The species was once found throughout the Greater Puerto Rican Bank, but currently survives exclusively in the British Virgin Islands, with the only remaining natural population on Anegada. Between 1984 and 1986, eight adult *C. pinguis* were translocated from Anegada to Guana to found a conservation insurance population on an island with fewer introduced mammalian species and significantly lower development pressure. Despite concerns that *C. pinguis* would not thrive in such disparate habitat, the species was successfully established, and offspring have been observed every year since 1987. Between 2003 and 2014, a long-term monitoring study was conducted to document the expansion of the Guana population. In 2014, we captured 169 individuals and recorded over 800 sight and resight records of both marked and unmarked individuals within the core research area. An additional 154 iguana sightings were recorded during distance sampling protocols conducted in the outlying portions of the island. Abundance estimates for the Guana *C. pinguis* population continue to increase island-wide, although density remains low in areas with high feral sheep abundance. Current efforts to cull feral sheep may have dramatic impacts on the iguana population. As conservation concerns within the British Virgin Islands continue to increase, insurance populations, such as the one on Guana, may play a critical role in the long-term conservation of the species.



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**Developing Habitat Restoration Model for Narrow-mouth Frog (*Kaloula borealis*)**

Amphibians have been considered an important taxon that is threatened with extinction globally due mainly to climate change and habitat destruction. Narrow-mouth Frog *(Kaloula borealis)* is the only amphibian species belonging to the *Kaloula* genus inhabiting Korea. The size of the population and habitats has been significantly decreased on the national scale, due to the urban development and the use of agricultural pesticides. Accordingly, the Ministry of Environment listed this species as “Endangered Species (Class II)” under the “Endangered Species Protection and Management Act”. Nevertheless, few studies have focused on habitat restoration that would be essential to preventing the extinction of the species and destruction of remaining habitats.

We developed a Habitat Suitability Index (HSI) for the narrow-mouth frog with emphasis on five variables of space, feed, cover, breeding and threatening elements. Based on the HSI criteria, a three-dimensional spatial model was created to help visualize the physical requirements of the habitat. A set of criteria and HSI’s spatialization would be useful in replacing an existing habitat or creating a new one often materialized as *substitute habitat* that are required when development influences the habitat area. To test the validity of the model, several experimental sites were selected in urban setting and the survivor rate and adaptability of the species are being under investigation. The results of the study will provide useful information to improve habitat’s condition for better protecting the species or identify a new suitable place that works for the species’ life cycle and meets habitat requirements.

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**Pipeline Rights of Way Revegetation In The Eagle Ford Shale Oil And Gas Play**

Recent oil and gas exploration across the United States have had many negative impacts on rangelands. Reseeding native plants to oil and gas pipeline rights of ways to help minimize rangeland disturbance for wildlife and livestock is a common practice in the Eagle Ford Shale of South Texas. The Eagle Ford Shale oil and gas play is a geologic formation roughly 400 miles long by 50 miles wide that stretches from east Texas across south Texas and into Mexico. From 2010-2013, more than 25,749 km (16,000 mi) of new pipeline ROWS were added in the State of Texas. Commercial availability of large supplies of ecotypic seeds has led to an increase in the use of native plants for revegetation along new rights of ways in the region.

*South Texas Natives* (STN) in collaboration with Texas A&M Agrilife Extension, Texas Parks and Wildlife Department, and the United State Department of Agriculture-Natural Resources Conservation Service (USDA NRCS), studied the effectiveness of standard industry planting techniques and to quantify the performance of various commercially available native plant seed sources developed by STN and the USDA, NRCS E. "Kika" de la Garza Plant Materials Center. Experimental plantings were conducted following the installation of pipelines on two ranches within the Eagle Ford Shale. We evaluated 4 different planting methods and were successful with each when using a locally adapted native seed mix. Results from these projects demonstrated the utility of ecotypic native seeds in combination with a variety of planting methods to successfully restore native plants to rangelands following oil and gas activity in the Eagle Ford Shale region of South Texas.



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**Edwards Aquifer Region of South-Central Texas: Unique Challenges and Solutions for LID Implementation**

*Watershed Stewardship for the Edwards Aquifer Region: A Low Impact Development Manual, 2014*, is a booklet targeting developers and planners who wish to implement development stewardship practices within the Edwards Aquifer region. The unique physical challenges and regulatory environments of the Edwards and Trinity Aquifers have slowed the development of LID practices, which have begun to take hold elsewhere in central Texas. The manual is a resource designed to promote the use of LID across this sensitive region, proposing a set of practical, LID-based applications that will treat stormwater at the source and maintain aquifer integrity at each developed site. Utilizing current scientific research, pertinent regulations and vegetation and water management practices, the manual outlines practices that restore sites and aid in aquifer recharge.

In partnership with the San Antonio River Authority; the City of San Antonio and City Council representatives from Districts 8, 9 & 10; the Edwards Aquifer Authority; and the Guadalupe Blanco River Authority; the Greater Edwards Aquifer Alliance is working with Homeowners' Associations, school districts, colleges and universities, local governments and regulatory agencies to create ten Community Rain Gardens on the Edwards Aquifer Recharge Zone in San Antonio, Texas. These projects will engage participants through a series of presentations, planning exercises, and project implementation. Homeowners and students will learn how to maintain existing stormwater filtration systems, and will participate in installing Low Impact Development (LID) features such as swales, rain gardens, and site specific plantings to enhance filtration of stormwater before it enters the Aquifer.